

Biological Evaluation
of the
Gypsy Moth Outbreak
on the
Allegheny National Forest
Pennsylvania

1988

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BIOLOGICAL EVALUATION OF THE GYSPY MOTH
OUTBREAK ON THE ALLEGHENY NATIONAL FOREST
1988

SUMMARY

Moderate to severe defoliation occurred on the Allegheny National Forest in 1988 on the Ridgway and Marienville Ranger Districts. Concentrated and scattered mortality has occurred on all four Ranger Districts, especially Sheffield Ranger District. While populations have collapsed over most of the forest, some retreatment of 1988 spray blocks, and treatment of new blocks in the Ridgway Ranger District is recommended for the spring of 1989.

INTRODUCTION AND BACKGROUND

Over the past five years the area defoliated by gypsy moth (*Lymantria dispar* L.) has increased from a little over 2,000 acres to over 100,000 acres on the Allegheny National Forest. The Ridgway Ranger District received its first noticeable defoliation in 1988. The distribution of defoliation by year and ranger district is summarized below:

Gypsy Moth Defoliation - All Ownerships

Ranger District	1984	1985	1986	1987	1988
-----ACRES-----					
Bradford	0	4799	41,313	6160	0
Marienville	2024	4000	20,311	6880	1690
Sheffield	0	843	16,441	102,600	0
Ridgway	0	0	0	0	2360

TOTALS	2024	9642	78,065	115,640	4290

It should be noted that 1985, 1986, and 1988 defoliation was determined from high altitude aerial photography, while 1984 and 1987 defoliation were from aerial sketchmapping. Maps 1 through 12 of Appendix A show the defoliated areas as interpreted from high altitude optical bar photography. Table 1 details the defoliated areas by ownership and severity class on each of the Ranger Districts.

OBJECTIVE

As in previous years, areas were surveyed that by nature of their oak component are presumed to be susceptible to gypsy moth defoliation. Areas that are

predominately northern hardwood or Allegheny hardwood are not expected to sustain populations of gypsy moth that cause more than minimal damage. Egg mass surveys were conducted in susceptible timber types to determine where the level of infestation was high enough to cause moderate to heavy defoliation (greater than 30% of the foliage stripped from the canopy) in 1989. Surveys of certain additional high use recreation areas were conducted despite their lack of oak timber type, because of the nuisance to users and potential for transportation of larvae associated with these areas. Also surveyed were areas of Aspen, a preferred host of the gypsy moth and a valuable wildlife food source.

SURVEY PROCEDURE

Each Ranger District was divided into "Entomological Areas" containing between 1,400 and 19,000 acres of Forest Service land and several compartments with significant oak or aspen components. Two new entomological areas, R-3 in Ridgway and M-11 in Marienville were formed and egg mass survey were conducted in 1988. These entomological areas and their corresponding compartments are shown on Maps 4-14 and acreage in Forest Service ownership shown on Table 5 of Appendix B. Approximately sixteen 1/40 acre, circular plots were distributed throughout each Entomological Area. These plots were placed in the same general locations as in the 1987 survey, except where areas had been sprayed in the 1988 suppression project; sprayed plots were replaced by adding new plots in other locations. All new egg masses were counted within these plots and used to calculate egg masses per acre. An average number of egg masses per acre with 95% confidence limits are presented for each of the entomological areas in Table 2, Appendix B.

Additional information taken at these sample plots included the approximate percentage of oak in the stand by percent cover (to help interpret variations in egg mass counts), the general size of the egg masses and the presence of parasites (Ooencyrtus wasps) on the egg masses. These latter two give an indication of the health of the population and whether it is declining or increasing.

During the 1987 egg mass survey, the five-minute walk technique was used to sample areas which had not been sampled before to try and detect isolated gypsy moth populations. Such areas included the Twin Lakes and Loleta recreation areas and the Kane Experimental Forest. Because of time limitations, five minute walks were not conducted in the 1988 survey.

OBSERVATIONS

In the areas of the Allegheny National Forest most severely defoliated during the past few years, gypsy moth populations have either collapsed or are declining. In portions of these areas, however, populations still exist at higher than expected densities. This appears to be due to the limited

population reduction obtained from the use of Bacillus thuringiensis in the 1988 spray project. Presumably, the surviving larvae in the sprayed areas had less competition for food and were less susceptible to the viral disease that caused the natural collapse of the general population. Correlations between egg mass density and defoliation of host type have been presented by David Gansner, NEFES, Broomall, and were used to predict the potential 1989 defoliation; greater than 750 egg masses per acre can be expected to cause moderate defoliation (30-60%) and greater than 1500 egg masses per acre can result in severe defoliation (60-100%). Potential defoliation for each of the Entomological Areas is presented in Table 3 of Appendix B. Moderate to severe defoliation is predicted for all of the Entomological areas in the Ridgway Ranger District. This area totals approximately 21,000 acres. Parts of M-7, M-8 and M-11 in the Marienville Ranger District may also receive moderate to severe defoliation in 1989. Entomological Area M-11 contains stands of Aspen scattered throughout, so the 19,500 acre area would not be entirely jeopardized. About 9% of the Bradford Ranger District in B-6 can expect moderate defoliation in 1989, while the Sheffield Ranger District is predicted to receive only to light defoliation.

PEST MANAGEMENT ACTION

The most practical alternative actions for dealing with the gypsy moth outbreak on the ANF in 1989 and in future years (as appropriate) involve the range of alternatives developed from the 1987 Environmental Assessment prepared by an interdisciplinary team of the ANF and FPM personnel. These alternatives can be summarized as follows and are to be applied to compartment(s) and recreation areas which will experience moderate to severe defoliation in 1989.

1. No suppression, but may salvage timber which may die as a result of defoliation.
2. Treatment with biological insecticide to protect trees on developed recreation sites and in wildlife areas and reduce larval nuisance and hazard tree risk to recreationists, (threshold limit 500 EM/AC).
3. Treatment with biological and/or chemical insecticide as appropriate to protect high-value oak timber stands that were thinned in the last five years or that may be thinned or harvested in the next five years, (threshold limit 750 EM/AC) and especially those spray blocks unsuccessfully treated in 1988 (threshold limit 500 EM/AC).
4. Combination of Alternative 2 and 3.
5. Alternative 3 plus treatment of low-value oak timber stands with a chemical insecticide to reduce the build-up and spread of gypsy moth in subsequent years from stands which currently have very high egg mass counts.
6. A combination of 2 and 5.
7. Alternative 6, but treatment material exclusively a biological insecticide.

The following discussion of the alternative identified above does several things: (1) anticipates the degree of resource protection from each; (2)

provides other positive and negative features of each; (3) estimates the time before retreatment; and (4) identifies our preferred alternative.

The alternative involving no suppression will not protect any resource value whereas suppression actions of aerially applying insecticides will prevent moderate to severe defoliation and mortality of forest trees. Usually, about 20-40 percent of the basal area is killed within five years following two to three consecutive years of moderate to severe defoliation in unmanaged stands compared to 30-90 percent of the residual stocking dying in thinned stands with the same defoliation history. Spraying has other positive benefits including reducing larval densities to innocuous levels thereby reducing the spread of gypsy moth in subsequent years from treated forest areas into adjacent untreated ones. The only benefits of no suppression would accrue to wildlife species which can take advantage of an abundance of food and whose habitats are defined by sparse tree stocking, more canopy openings, increased presence of snags or increased presence of forbs and shrubs.

Without any suppression, the present gypsy moth outbreak will not continue indefinitely but will run its course with the next year or two on the Allegheny NF. The gypsy moth has now established itself in the forest ecosystem, and has caused moderate to severe defoliation for two or three successive years in most parts of the oak forest type. Natural population collapse typically comes from an epizootic of the naturally occurring gypsy moth virus following a period of starvation brought on by total consumption of available food. This situation has now occurred throughout much of the Allegheny National Forest.

Forested areas where the microbial B.t. are applied generally have a higher residual gypsy moth population than equivalent areas treated with chemical Dimilin. Consequently, retreatment might be needed the next year in about one-quarter of the B.t. treated areas. However, spray block size and shape relative to adjacent population densities sometimes necessitate retreatment even in Dimilin sprayed areas. The period of potential annual retreatment should not exceed the duration of the outbreak phase (1-3 years) of the typical gypsy moth population cycle.

PREFERRED ALTERNATIVE

Our preferred alternative for dealing with the current gypsy moth outbreak on your Forest involves actions consistent with resource management objectives and values at risk. Thus, suppression of the outbreak should be considered for any high-value oak stand and high-use recreation site occurring in Entomological Areas where the trend in resident gypsy moth populations remain static at high densities or expected to increase and cause moderate or severe defoliation. Even Entomological Areas where a decreasing population trend is expected to result in light defoliation from low density resident populations, candidate areas for spraying may exist if there is a high potential for massive blow-in of 1st instar larvae from an outbreak area within a mile or two.

In conclusion, we prefer: 1) the use of B.t. in certain developed recreation areas applied once at maximum dosage to high density healthy populations; 2) Dimilin or B.t. in specific high-value oak timber stands thinned within the last five years or planned to be cut within the next five years. Extremely dense populations of gypsy moth in low-value, low-use forested areas would be left to collapse from natural controls where this has not occurred already. Alternative

4 provides this pest management approach emphasizing suppression treatments only where they are urgently needed to protect the highest resource values currently under the greatest risk from the gypsy moth outbreak. Treatments being considered are biologically the most effective, environmentally the most acceptable, and economically the most beneficial.

Ranger District	Total Acreage Surveyed	Average Defoliation Potential by Intensity Class		
		Light	Moderate	Severe
-----Percent-----				
Bradford	67,415	91	9	0
Marienville	53,682	80	10	10
Ridgway	21,221	0	50	50
Sheffield	66,546	100	0	0
Allegheny NF	208,864	82	10	8

From Appendix B, Table 3, we believe it is possible to obtain a more localized idea about the infestation trend and average defoliation expected in susceptible host type within each Entomological Area. The average defoliation class and the range of classes are based on the average egg mass density per acre and its confidence interval (C.I.) set at 5 percent probability. For example, the susceptible oak forest within the 9649 acres of Ridgway Entomological Area-3 would, on the average, experience moderate defoliation as the gypsy moth population there should remain fairly abundant in 1989. Using the C.I. for average egg mass density, moderate defoliation there seems inevitable as the lower limit of the estimate remains very close to the moderate threshold.

CONSEQUENCES OF THE OUTBREAK ON FOREST RESOURCES

Recreational Areas predicted to experience moderate to severe defoliation would be adversely affected by the nuisance and aesthetic degradation caused by massive numbers of larvae next spring. Tree defoliation with resultant tree mortality can permanently affect the recreational setting by first denying users the green, shaded forest environment they expect and later by increasing the risk to recreationists from hazard trees.

Permanent damage to timber producing stands from gypsy moth outbreaks is most acute where trees are moderately to severely defoliated for several successive years. Tree mortality may occur sooner in previously thinned stands managed for timber values. However, the influence of past cutting activity and residual stocking, together with the onset of defoliation and its intensity and frequency on subsequent tree mortality, have yet to be fully documented by forest pest management surveys or elucidated by research study plots. Although there were no sprayed areas on the Allegheny National Forest that received moderate to severe defoliation in 1988, some areas still contain populations exceeding 500 egg masses per acre and should receive special attention, as they may have received 2 years of defoliation already and have previously been identified as vulnerable areas.

APPENDICES

This index lists the tables and maps contained in each appendix to this report.

APPENDIX A

Table 1. 1988 Gypsy Moth Defoliation by Ranger District and Severity Class, Allegheny National Forest (1 page).

Maps 1-12. 1988 Gypsy Moth Defoliation, Allegheny National Forest, by Ranger District (12 pages)

APPENDIX B

Table 2. 1988 Gypsy Moth Egg Mass Survey Results, Allegheny National Forest (2 pages).

Table 3. 1989 Gypsy Moth Predictions, Allegheny National Forest (2 pages).

Maps 13-23. 1988 Gypsy Moth Egg Mass Survey, Entomological Areas, and Compartments Surveyed, by Ranger District (11 pages).

APPENDIX A

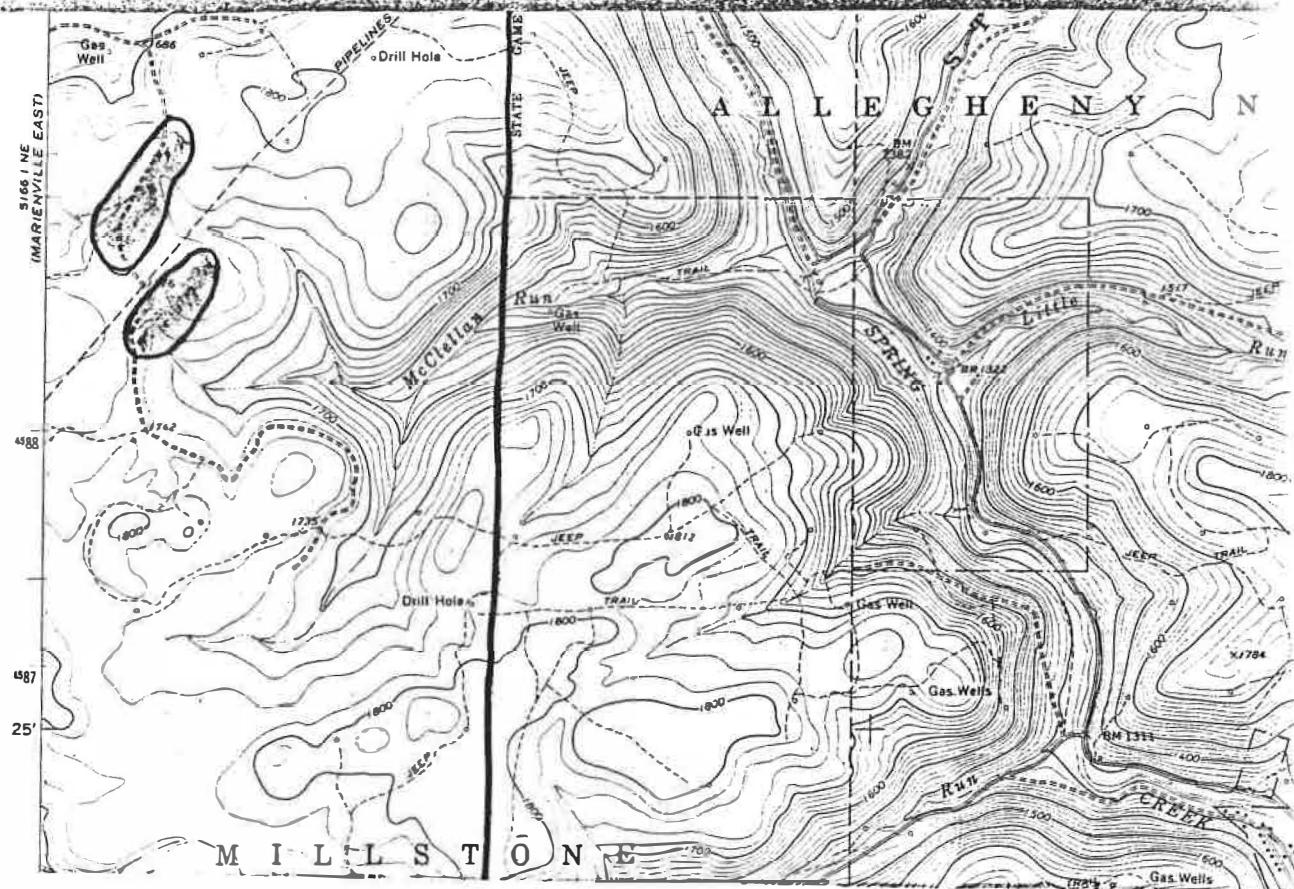
Table 1. 1988 Gypsy Moth Defoliation by Ranger District and Severity Class, Allegheny National Forest (1 page).

Maps 1-12. 1988 Gypsy Moth Defoliation, Allegheny National Forest, by Ranger District (12 pages)

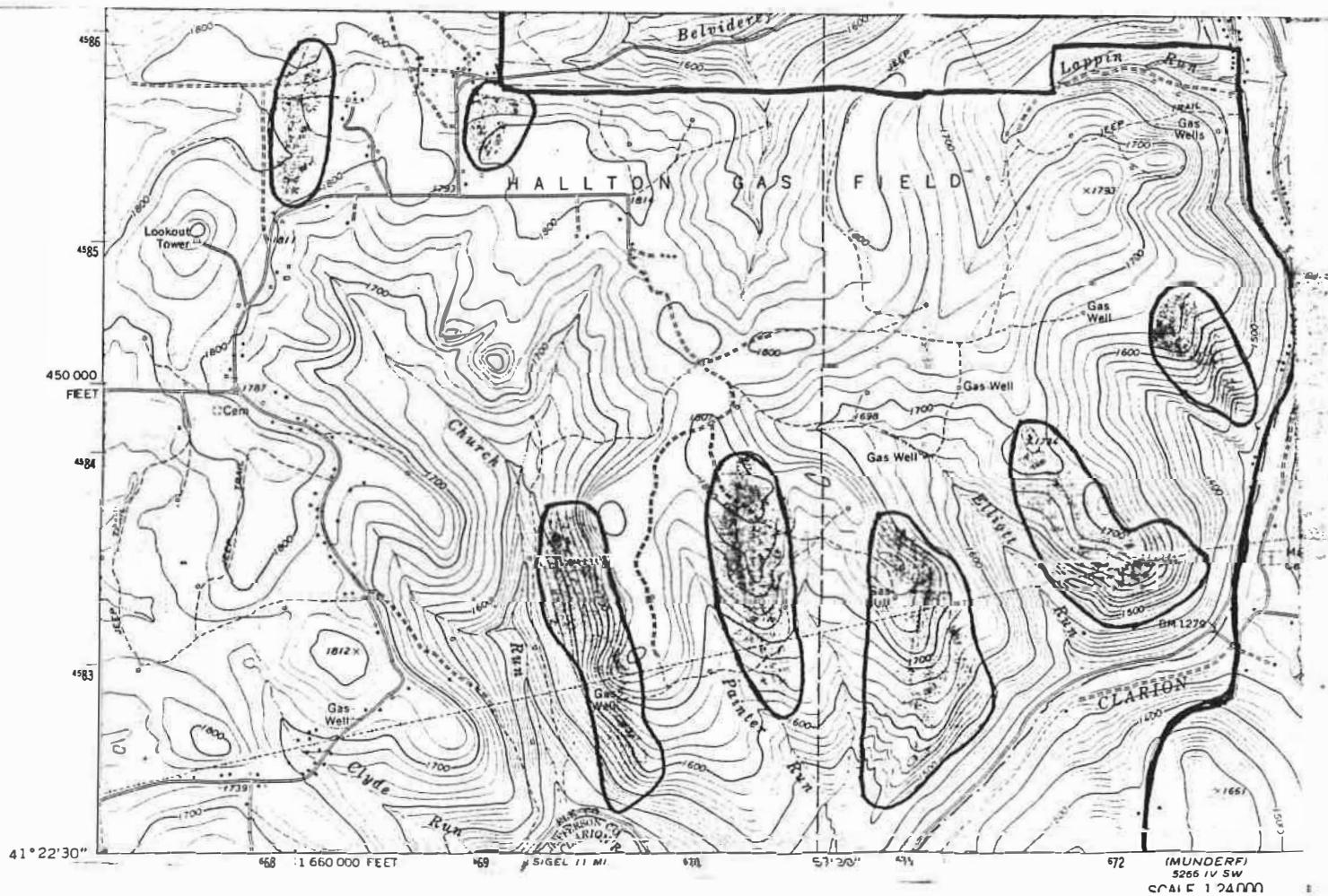
Table 1.--1988 Gypsy Moth Defoliation by Ranger District, Ownership and Severity Class. Allegheny National Forest.

Ranger District and Ownership	Acres by Defoliation Class		
	Moderate	Severe	Total
Marienville	1690	0	1690
--Forest Service Land	1270	0	1270
--State & Private Land	420	0	420
Ridgway	2600	0	2600
--Forest Service Land	2360	0	2360
--State & Private Land	240	0	240
Allegheny NF	4,290	0	4,290
--Forest Service Land	3,630	0	3,630
--State & Private Land	660	0	660

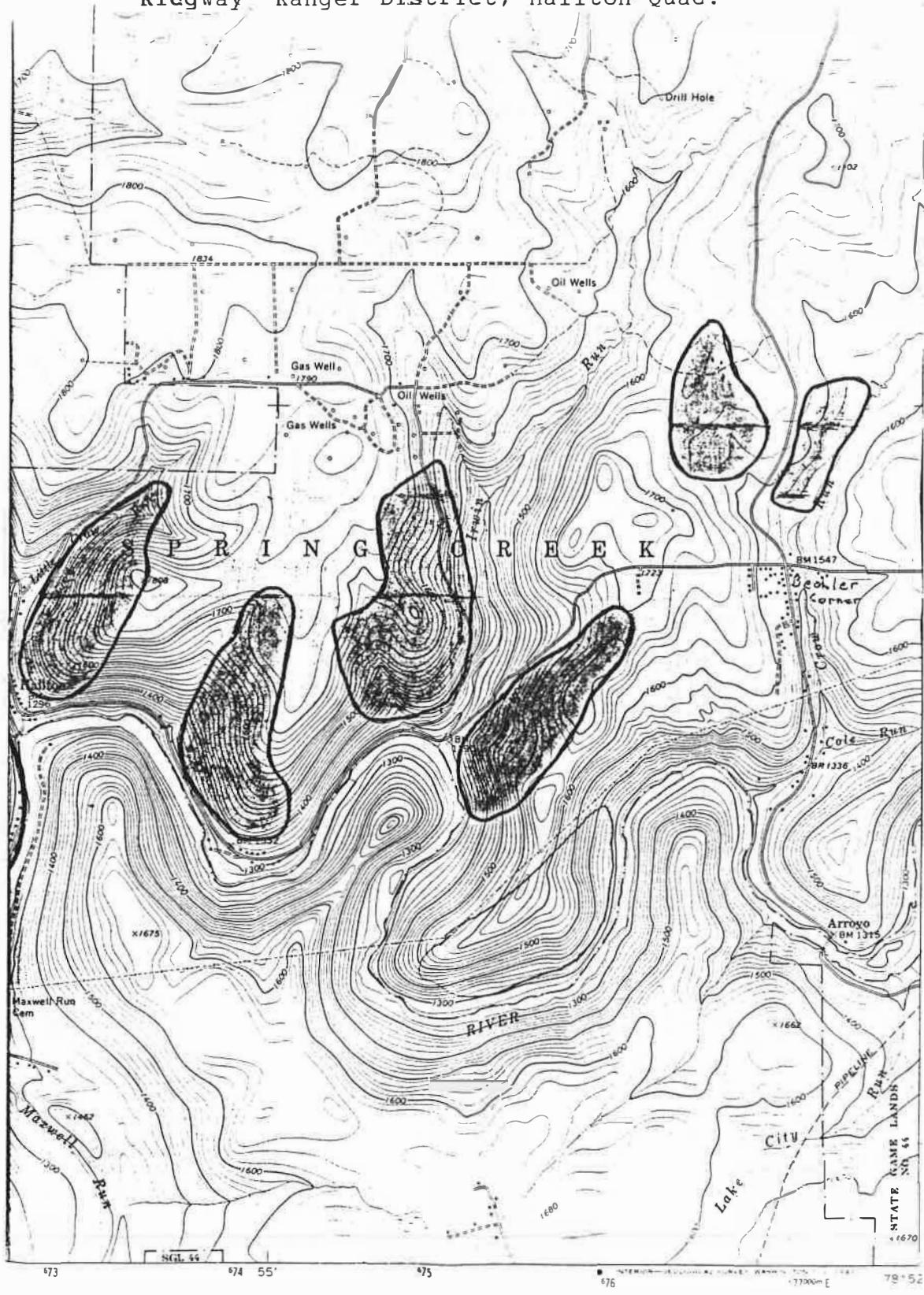
Map 1. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Marienville Ranger District, Hallton Quad.



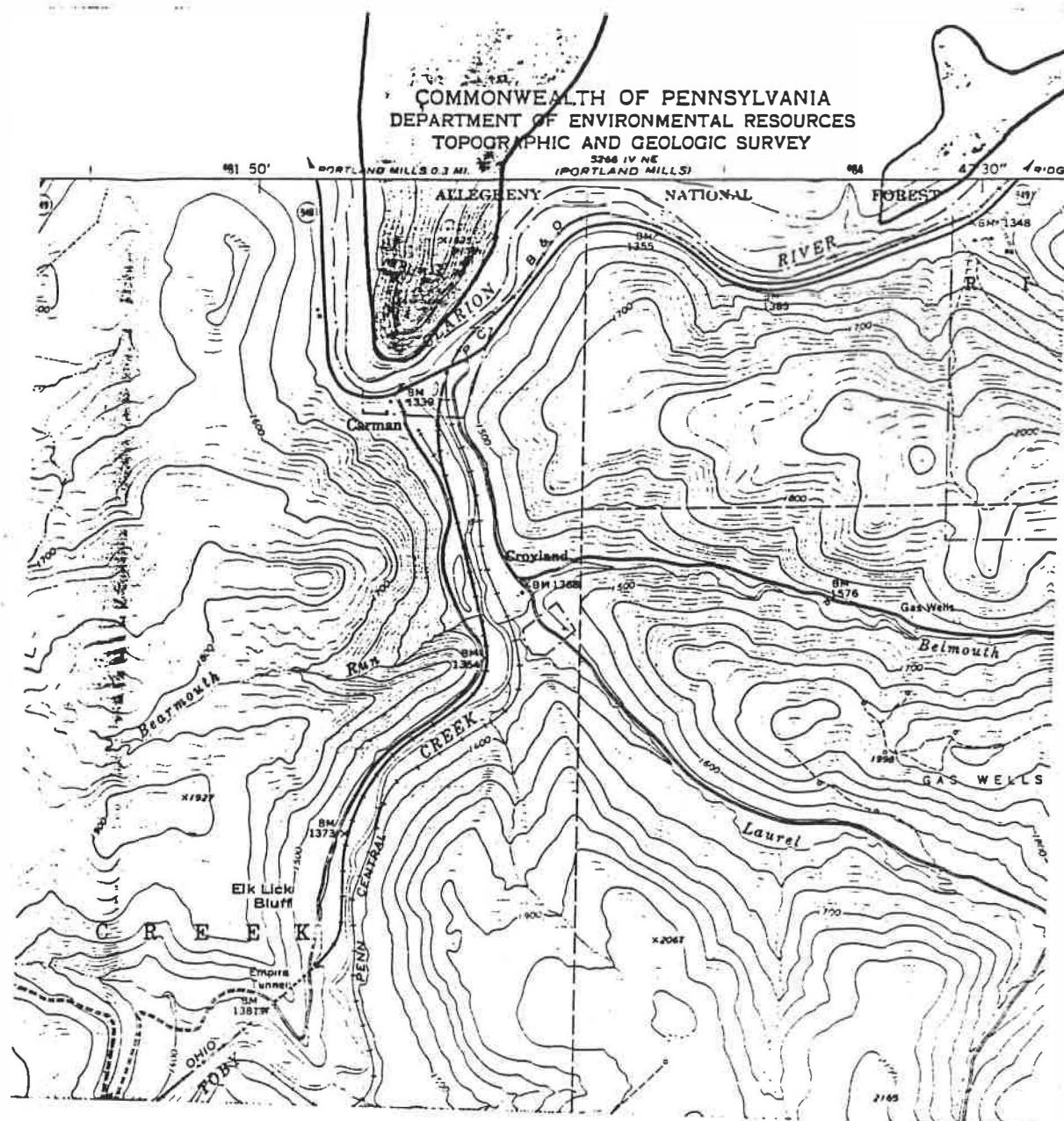
Map 2. 1988 Gypsy Moth Defoliation, Allegheny National Forest
Marienville Ranger District, Hallton Quad.



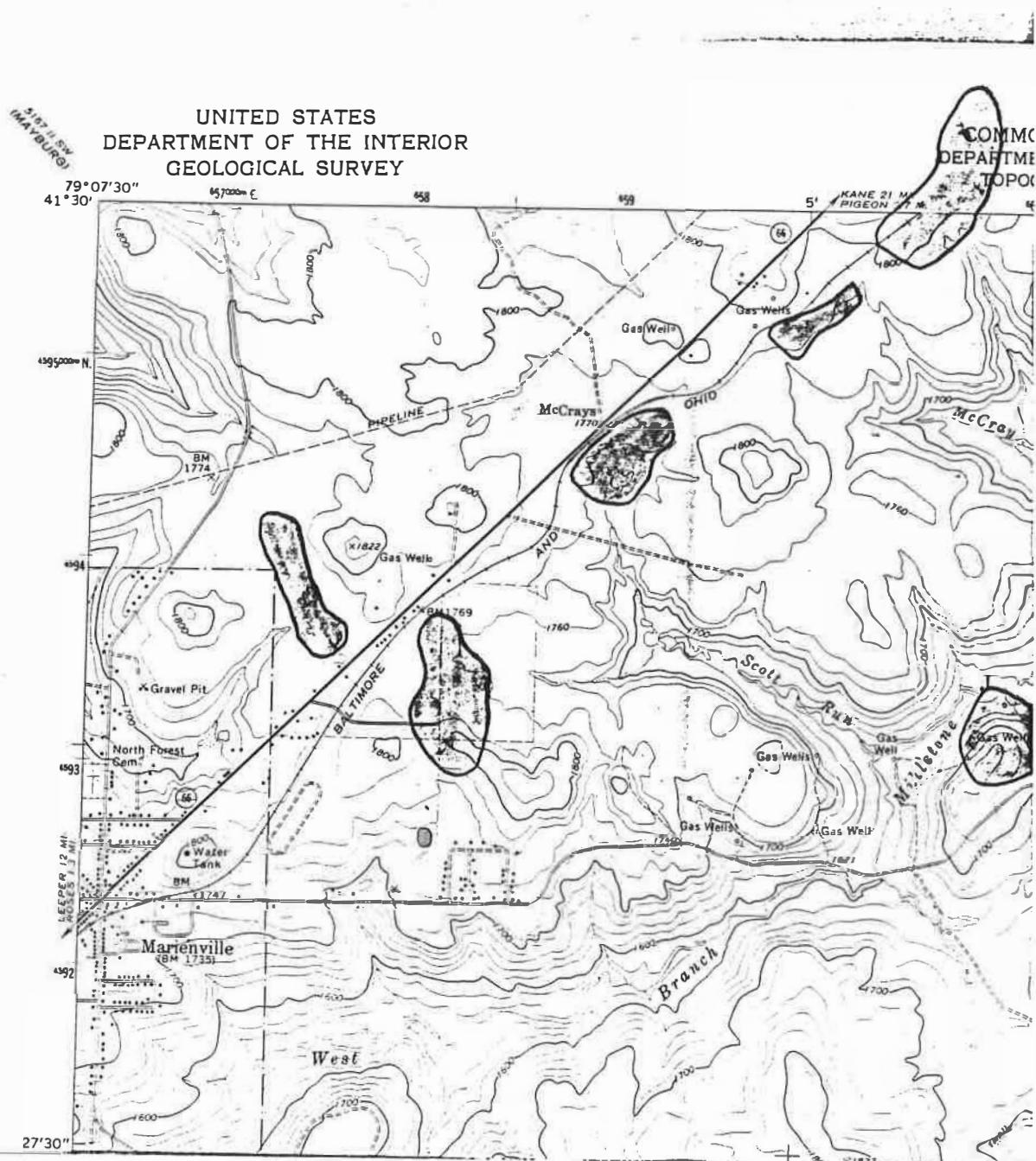
Map 3. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Ridgway Ranger District, Hallton Quad.



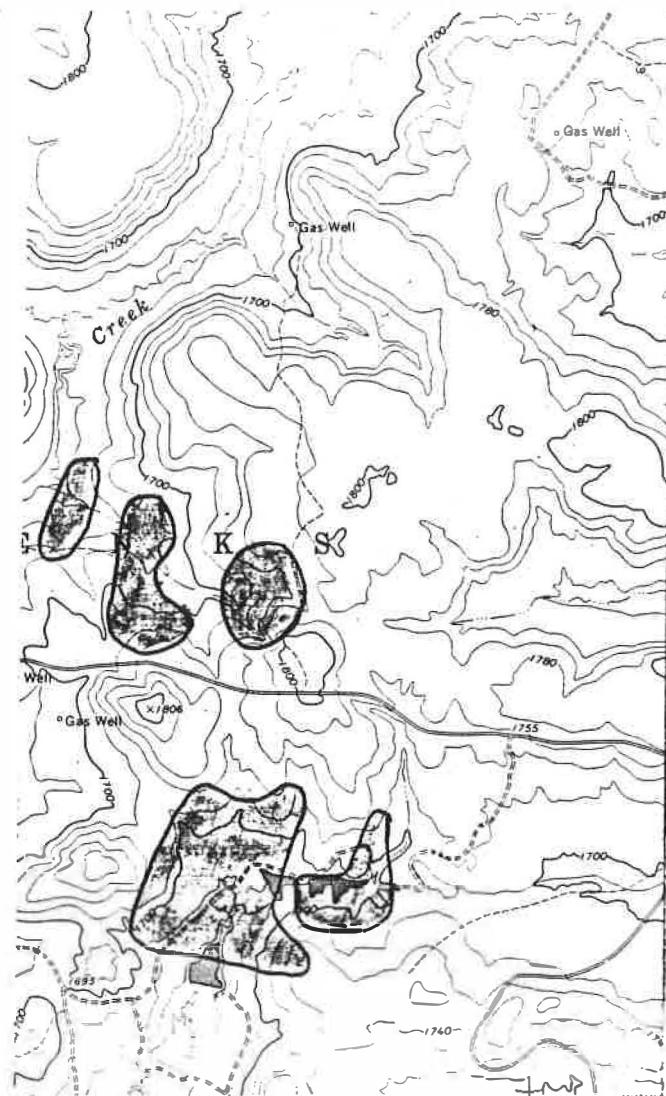
Map 4. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Ridgway Ranger District, Carman Quad.



Map 5. 1988 Gypsy Moth Defoliation, Allegheny National Forest, Marienville Ranger District, Marienville East Quad.

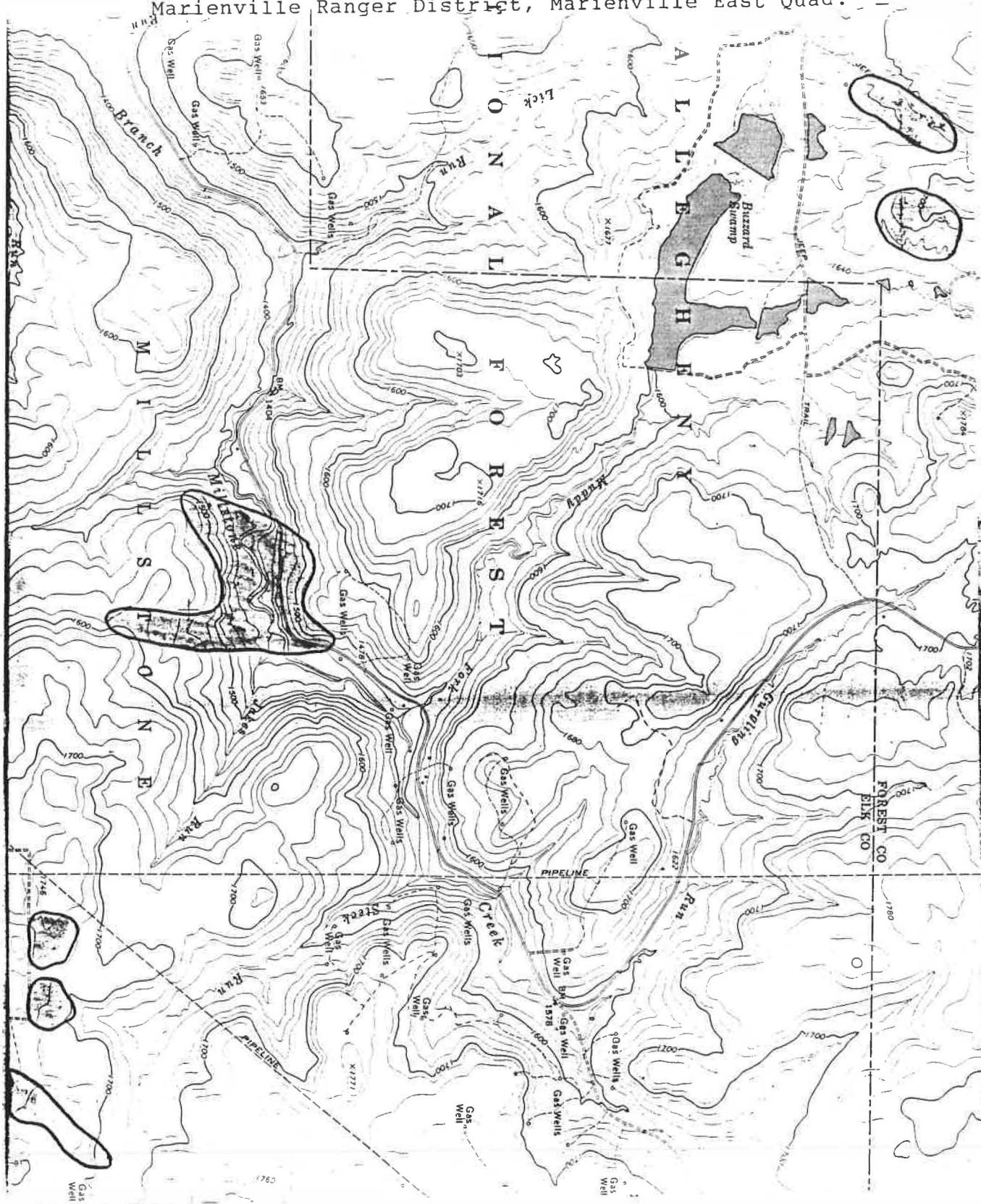


Map 6. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Marienville Ranger District, Marienville East Quad.

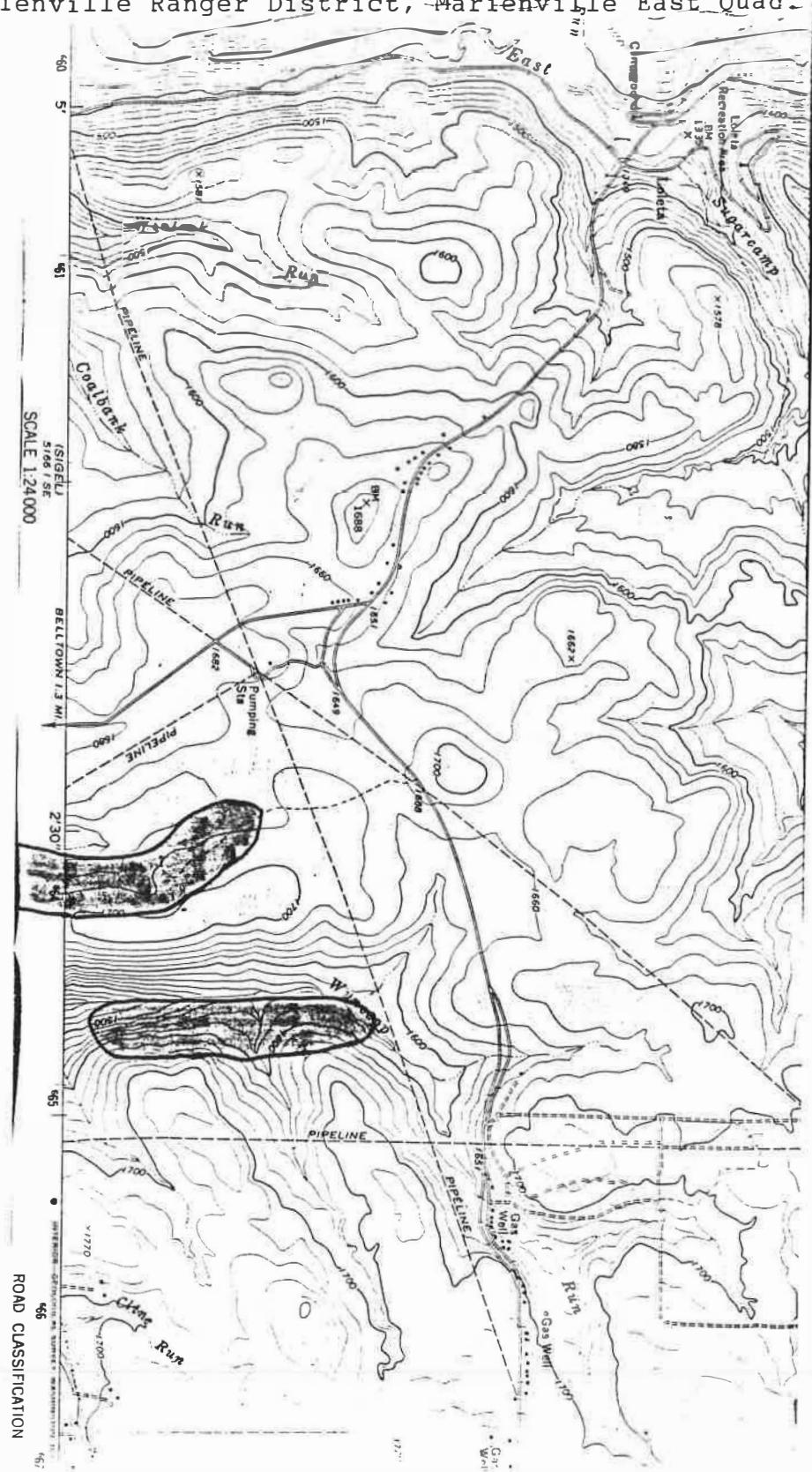


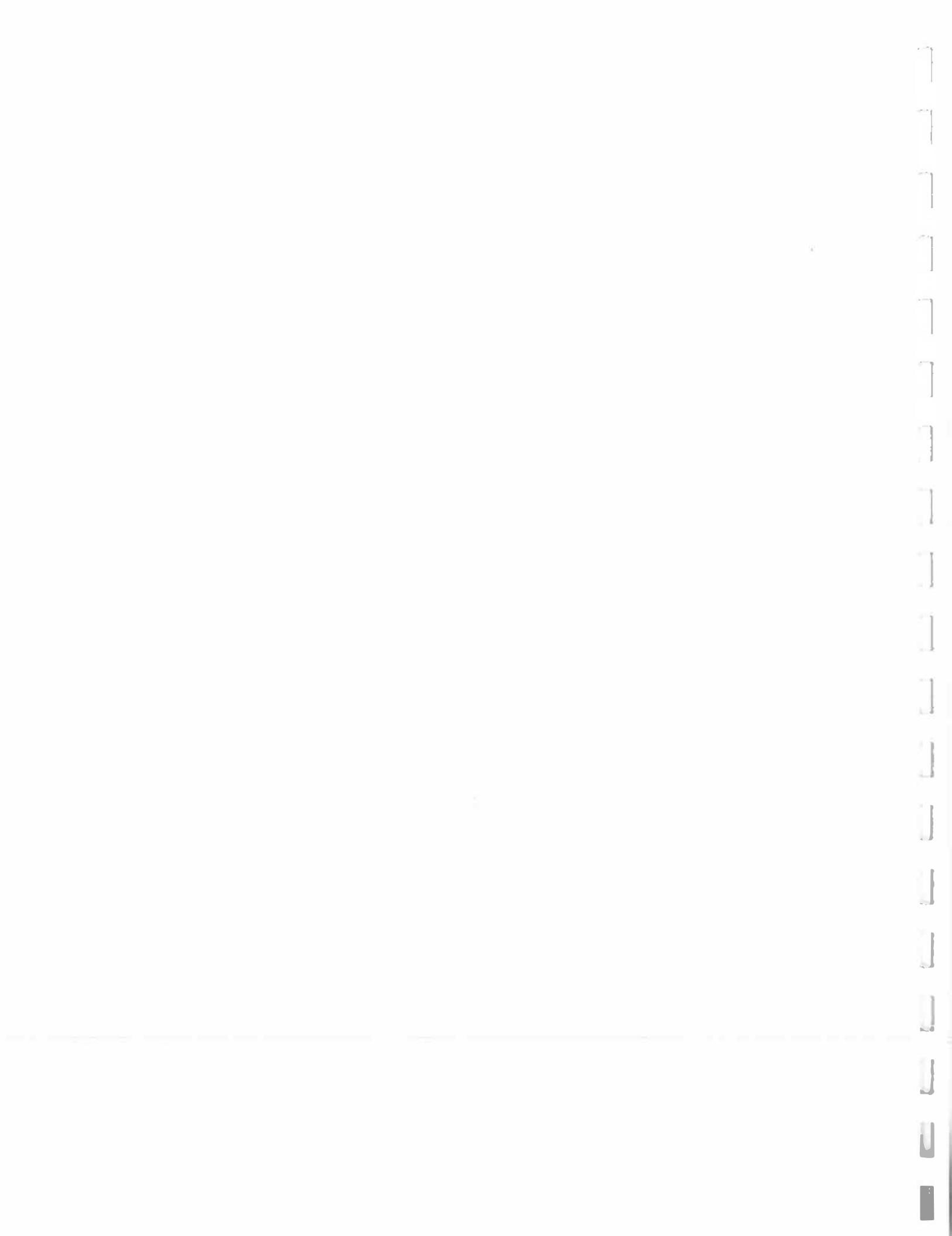
3 WITH NATIONAL MAP ACCURACY STANDARDS
GEOLOGICAL SURVEY, WASHINGTON, D. C. 20242
GRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

Map 7. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Marienville Ranger District, Marienville East Quad.

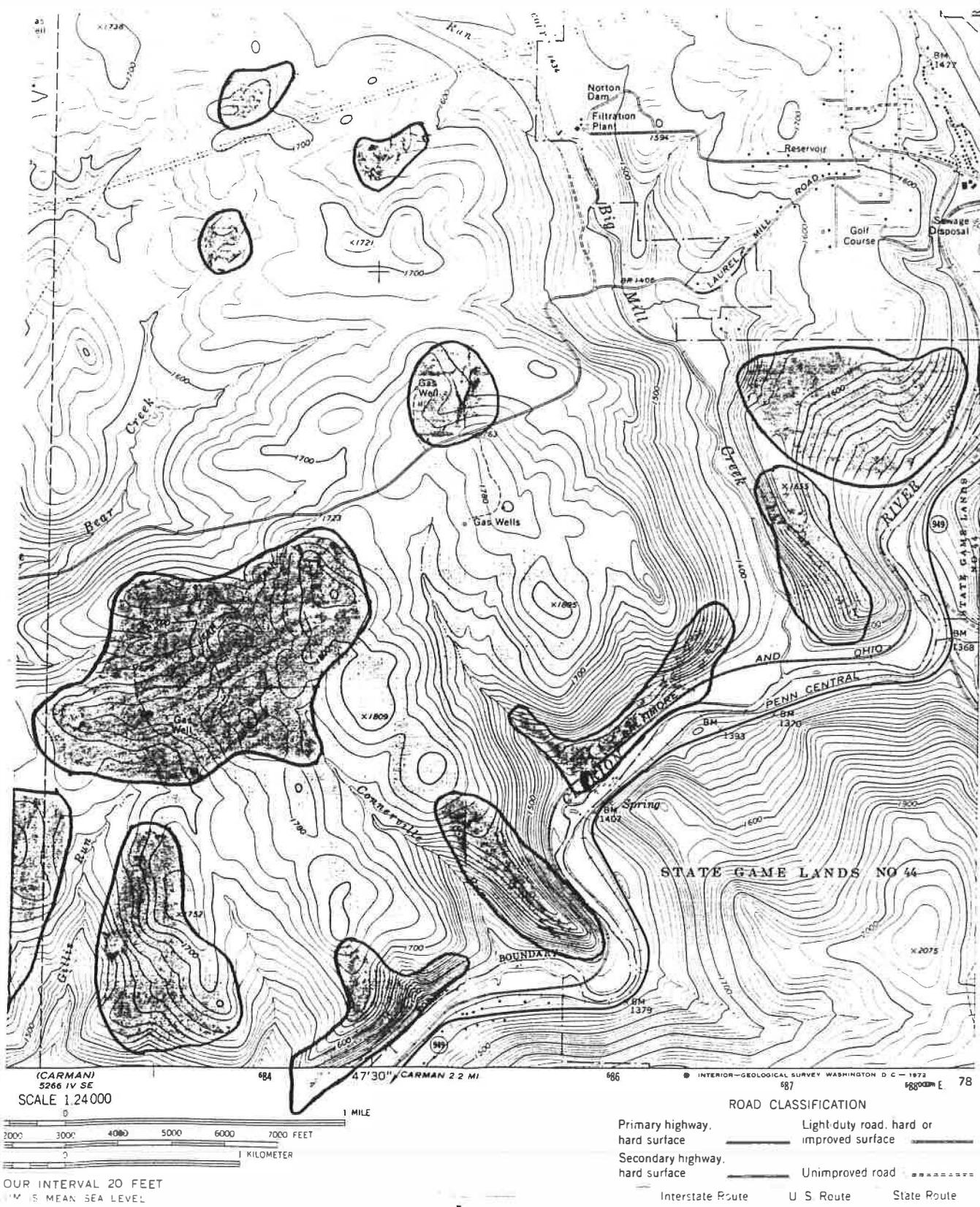


Map 8. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Marienville Ranger District, Marienville East Quad.





Map 9. 1988 Gypsy Moth Defoliation, Allegheny National Forest, Ridgway Ranger District, Portland Mills Quad.



Map 10. 1988 Gypsy Moth Defoliation, Allegheny National Forest, Ridgway Ranger District, Portland Mills Quad.



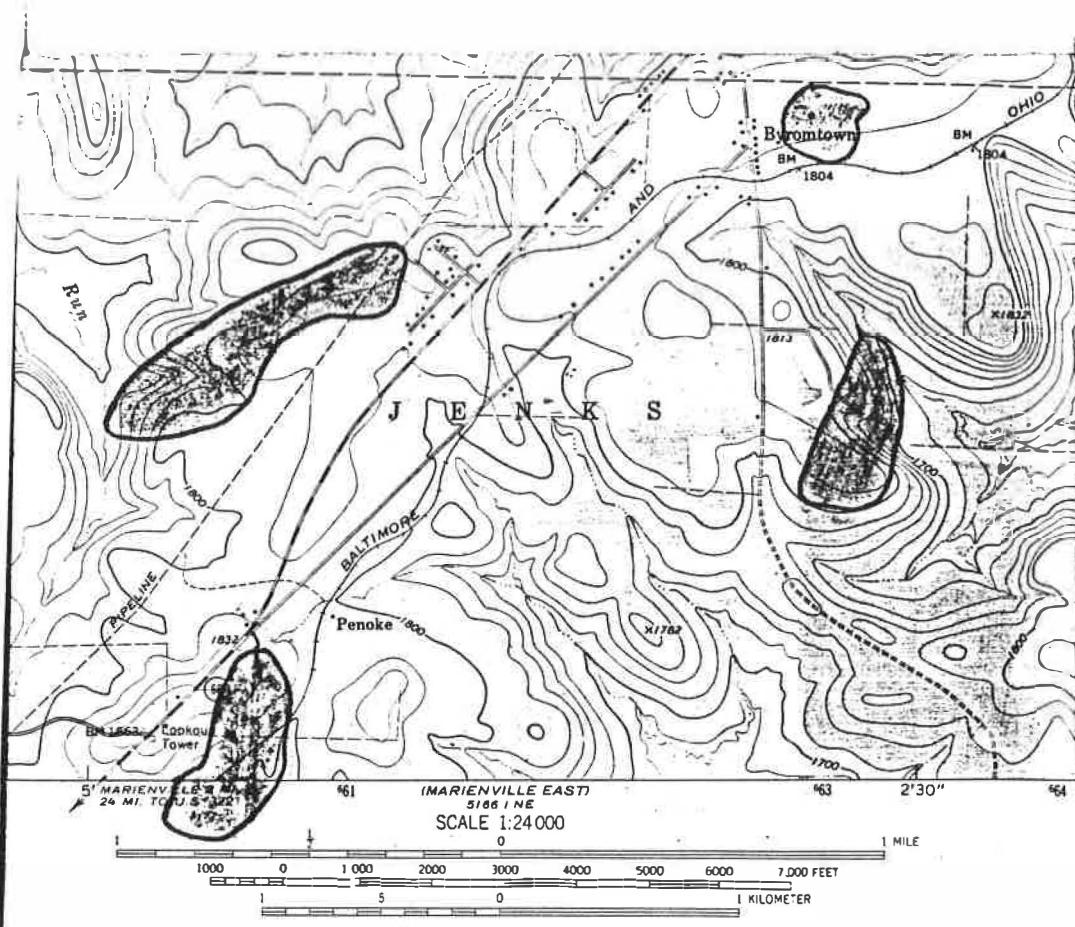
Mapped, edited, and published by the Geological Survey

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Topography by photogrammetric methods from aerial photographs taken 1968. Field checked 1969

Polyconic projection. 1927 North American datum
10,000-foot grid based on Pennsylvania coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks.
Scale 1:2, 000,000 Blue

Map 11. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Marienville Ranger District, Lynch Quad.

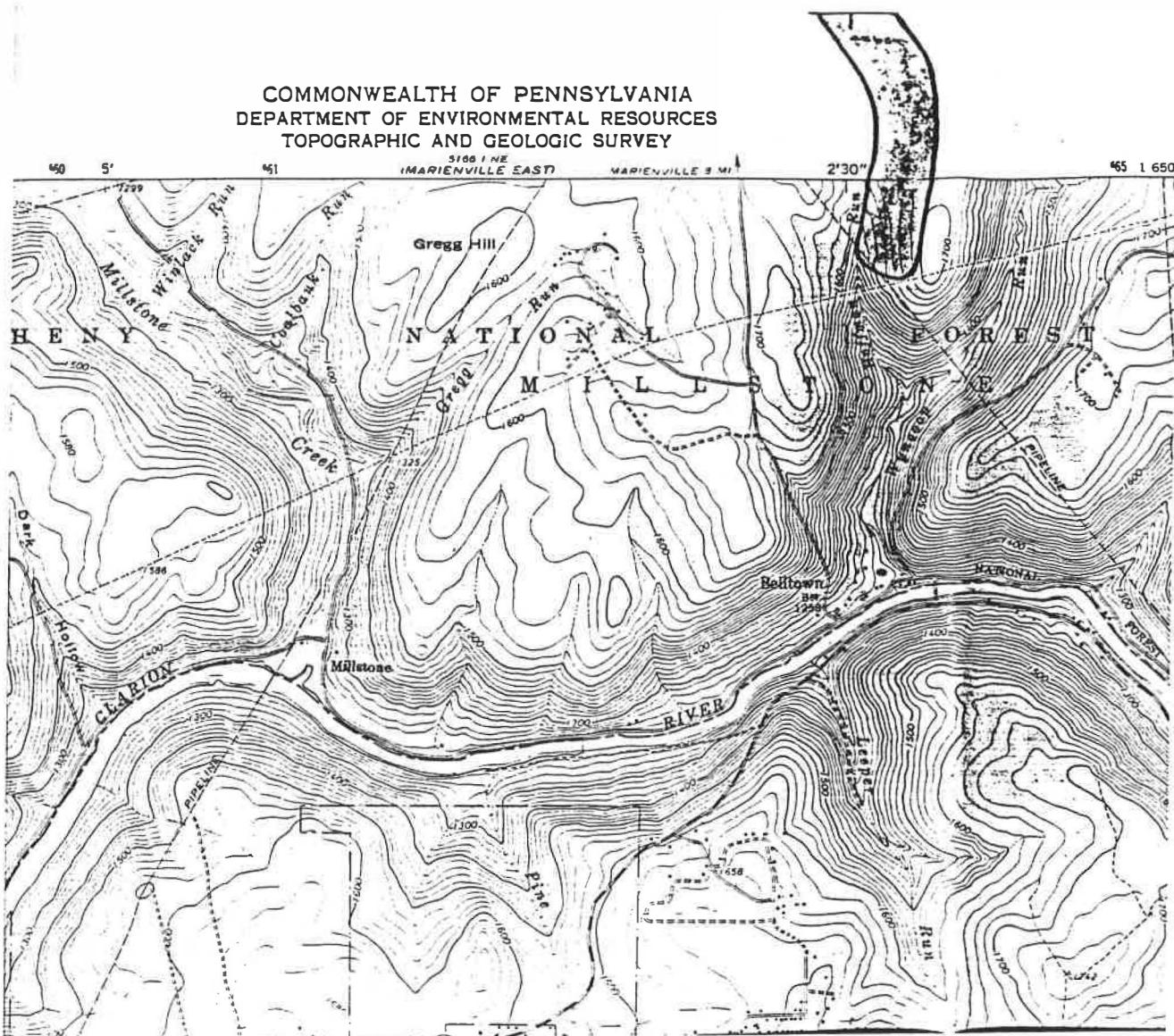


EPIC NORTH
OF SHEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

A small, rectangular white label with a black square in the upper right corner and the word "PENN" printed in black capital letters below it.

Map 12. 1988 Gypsy Moth Defoliation, Allegheny National Forest,
Marienville Ranger District, Sigel Quad.



APPENDIX B

Table 2. 1987 Gypsy Moth Egg Mass Survey Results, Allegheny National Forest (2 pages).

Table 3. 1988 Gypsy Moth Predictions, Allegheny National Forest (2 pages).

Maps 13-23. 1987 Gypsy Moth Egg Mass Survey Entomological Areas, and Compartments Surveyed, by Ranger District (11 pages).

Table 2.--1988 Gypsy Moth Egg Mass Survey Results, Allegheny National Forest, Bradford Ranger District.

ENTO AREA	AVERAGE EGG MASSES/AC ± CL	EGG MASS SIZE	APPROX % OAK ON PLOTS	% OF PLOTS WITH PARASITES	1988-1989 POPULATION TREND
B-1	126 ± 103	Large	20	0	Decreasing
B-2	73 ± 30	Medium/Large	23	0	"
B-3	220 ± 75	Medium/Large	71	40	"
B-4	60 ± 38	Medium/Large	44	100	"
B-5	115 ± 70	Medium/Large	6	8	"
B-6	540 ± 310	Medium/Large	56	58	Increasing
B-7	278 ± 239	Medium/Large	35	25	"
B-8	93 ± 112	Large	20	25	"
B-9	25 ± 30	Small-Large	26	13	Decreasing
B-10	110 ± 52	Large	35	13	"
B-11	77 ± 66	Medium/Large	9	0	Increasing
B-12	90 ± 101	Large	12	10	"

Table 2.--1988 Gypsy Moth Egg Mass Survey Results, Allegheny National Forest, Marienville Ranger District.

ENTO AREA	AVERAGE EGG MASSES/AC ± CL	EGG MASS SIZE	APPROX % OAK ON PLOTS	% OF PLOTS WITH PARASITES	1988-1989 POPULATION TREND
M-1	124 ± 66	Medium/Large	51	64	Decreasing
M-2	49 ± 56	Medium	35	15	"
M-3	77 ± 62	Large	31	21	"
M-4	75 ± 88	Small-Large	20	13	"
M-5	58 ± 40	Medium/Large	35	6	"
M-6	308 ± 310	Medium/Large	37	23	"
M-7	1720 ± 564	Medium/Large	50	50	Increasing
M-8	610 ± 336	Medium/Large	18	13	"
M-9	105 ± 64	Medium/Large	9	38	Decreasing
M-10	18 ± 20	Small-Large	48	25	"
M-11	1230 ± 901	Small-Large	2	67	Increasing

Table 2.--1988 Gypsy Moth Egg Mass Survey Results, Allegheny National Forest,
Ridgway Ranger District

ENTO AREA	AVERAGE EGG MASSES/AC + CL	EGG MASS SIZE	APPROX % OAK ON PLOTS	% OF PLOTS WITH PARASITES	1988-1989 POPULATION TREND
R-1	3825 + 1697	Medium/Large	44	56	Increasing
R-2	1003 + 444	Medium/Large	51	13	"
R-3	1327 + 491	Medium/Large	7	83	"

Table 2.--1988 Gypsy Moth Egg Mass Survey Results, Allegheny National Forest,
Sheffield Ranger District

ENTO AREA	AVERAGE EGG MASSES/AC + CL	EGG MASS SIZE	APPROX % OAK ON PLOTS	% OF PLOTS WITH PARASITES	1988-1989 POPULATION TREND
S-1	92 + 78	Medium/Large	38	0	Decreasing
S-2	5 + 10	Large	43	0	"
S-3	75 + 46	Medium/Large	47	0	"
S-4	78 + 38	Medium/Large	53	0	"
S-5	30 + 13	Small-Large	44	0	"
S-6	68 + 40	Medium/Large	43	20	"
S-7	35 + 26	Large	46	13	"
S-8	30 + 29	Medium/Large	11	0	"
S-9	(Missing)	(Missing)	(Missing)	(Missing)	(Missing)
S-10	80 + 68	Medium/Large	44	13	Decreasing
S-11	13 + 12	Medium	42	0	"
S-12	30 + 26	Large	41	25	"
S-13	12 + 17	Large	0	10	"

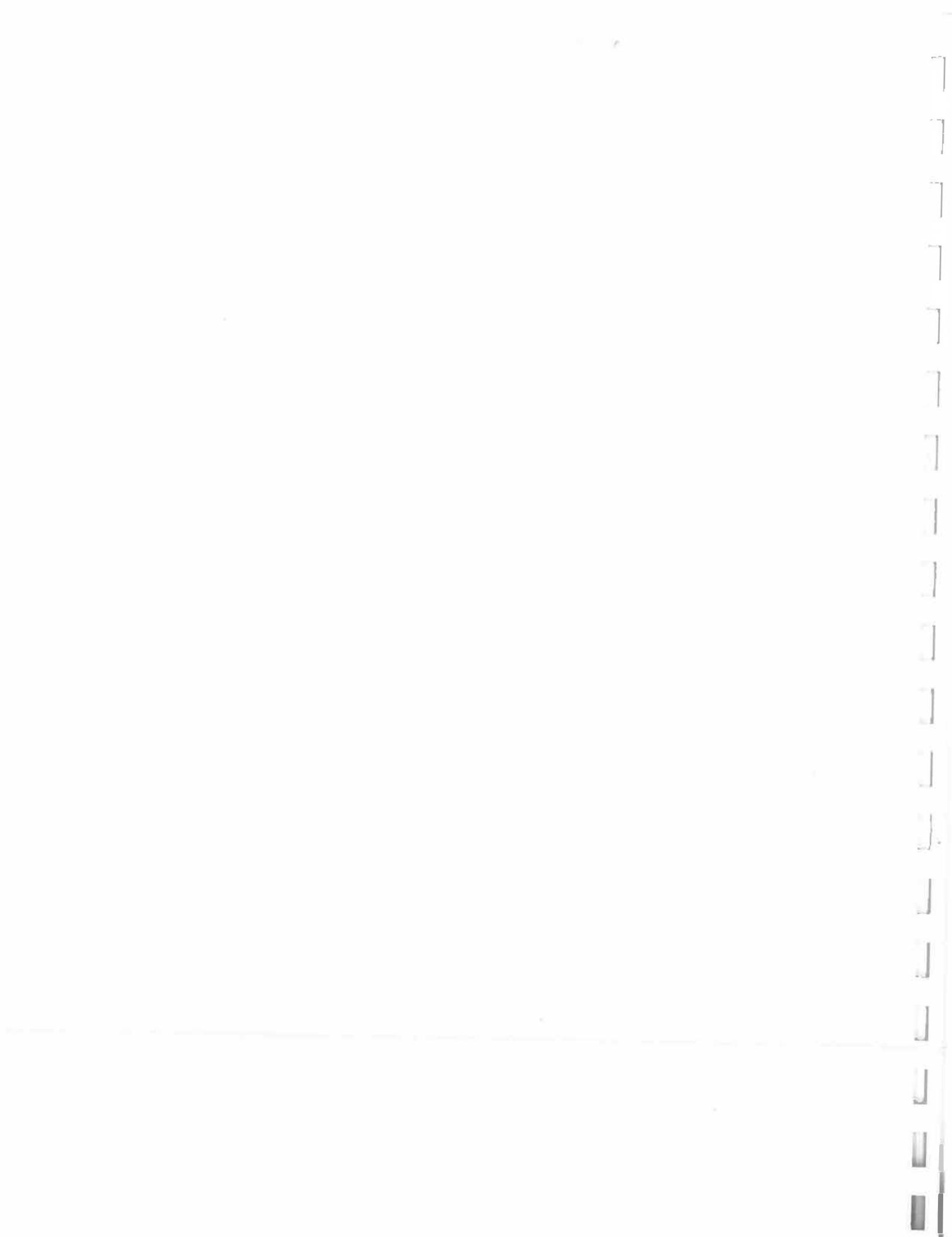


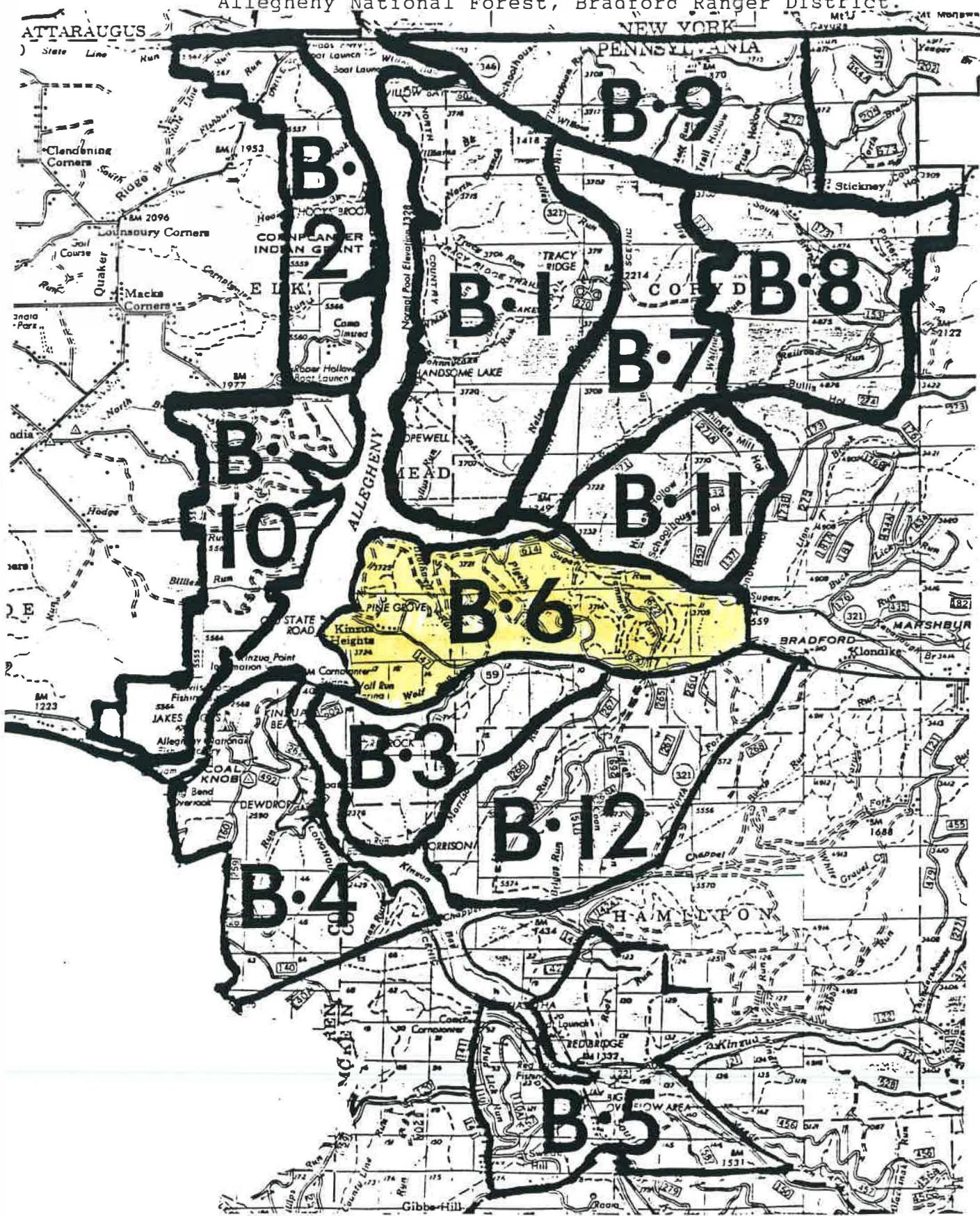
Table 3.--1989 Gypsy Moth Outbreak Predictions, Allegheny National Forest.

ENTO AREA	COMPARTMENT NUMBERS	NET ACREAGE	AVERAGE	RANGE
Bradford Ranger District		67,415		
B-1	9-17	9,188	Light	Very Light/Light
B-2	95-97	4,073	Light	Very Light/Light
B-3	46-49	4,805	Light	Light
B-4	86-90	5,943	Light	Very Light
B-5	57,58,76,94	5,042	Light	Very Light/Light
B-6	41-44	5,886	Light	Light/Moderate
B-7	18,20-23	4,967	Light	Light
B-8	24-28,30	4,344	Light	Very Light
B-9	1-4	6,078	Light	Very Light
B-10	98-100	5,330	Light	Very Light
B-11	31,34-35	4,392	Light	Very Light
B-12	50-54	6,367	Light	Very Light
Marienville Ranger District		53,682		
M-1	1-4,6	3,946	Light	Very Light/Light
M-2	5,7-10	2,559	Light	Very Light
M-3	13,14,17	2,392	Light	Very Light/Light
M-4	12,16,18,19	2,223	Light	Very Light
M-5	15,20,21,25	3,711	Light	Very Light
M-6	22-24,28	5,284	Light	Light/Moderate
M-7	65-67,77,90,91	4,126	Severe	Moderate/Severe
M-8	92,105,106	3,815	Light	Light/Moderate
M-9	29-32	4,680	Light	Very Light/Light
M-10	117-118	1,389	Light	Very Light
M-11	58-60,63,64,68-72, 78-80,93-95	19,559	Moderate	Light/Severe

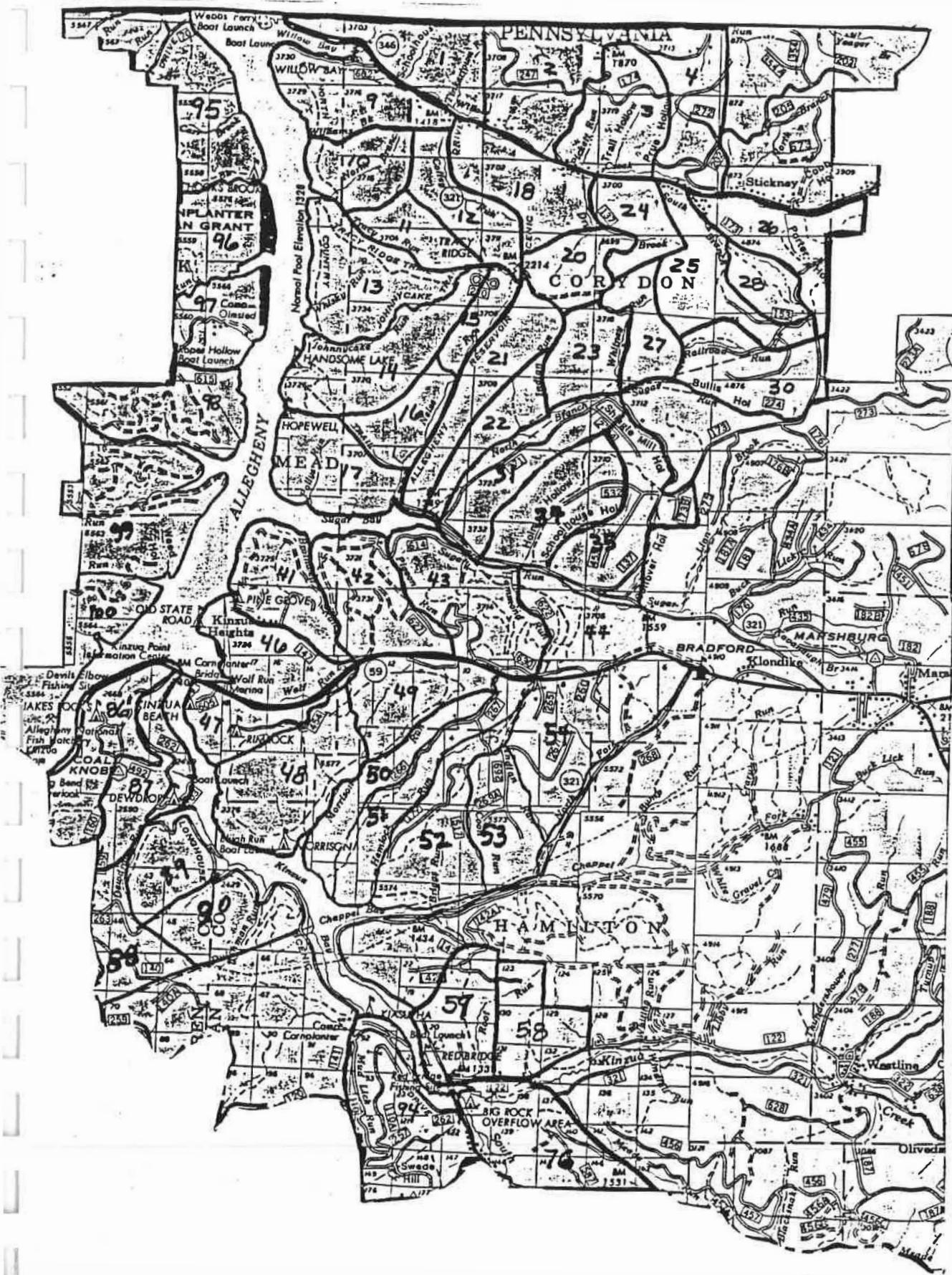
Table 3.--1989 Gypsy Moth Outbreak Predictions, Allegheny National Forest.

ENTO AREA	COMPARTMENT NUMBERS	NET ACREAGE	AVERAGE	RANGE
Ridgway Ranger District		21,221		
R-1	109-113	6,172	Severe	Severe
R-2	92,104-106,114	5,580	Moderate	Moderate/Severe
R-3	94,96,99-102,107,108	9,649	Moderate	Moderate/Severe
Sheffield Ranger District		66,546		
S-1	1,2,4-7	4,239	Light	Very Light/Light
S-2	8,9,18-20	4,543	Light	Very Light
S-3	21-24,28,29	5,787	Light	Very Light
S-4	3,25-27,49-52	7,790	Light	Very Light
S-5	81-85,128,129	4,028	Light	Very Light
S-6	53-55,77-78,87	4,093	Light	Very Light
S-7	130-133,148	5,819	Light	Very Light
S-8	76,89-91,118-121 141,155	10,010	Light	Very Light/Light
S-9	137-138,146-147	3,165	(Missing)	(Missing)
S-10	139-140,142,144,145	3,886	Light	Very Light/Light
S-11	150-154	4,041	Light	Very Light
S-12	10-16	7,136	Light	Very Light
S-13	34-35	2,009	Light	Very Light

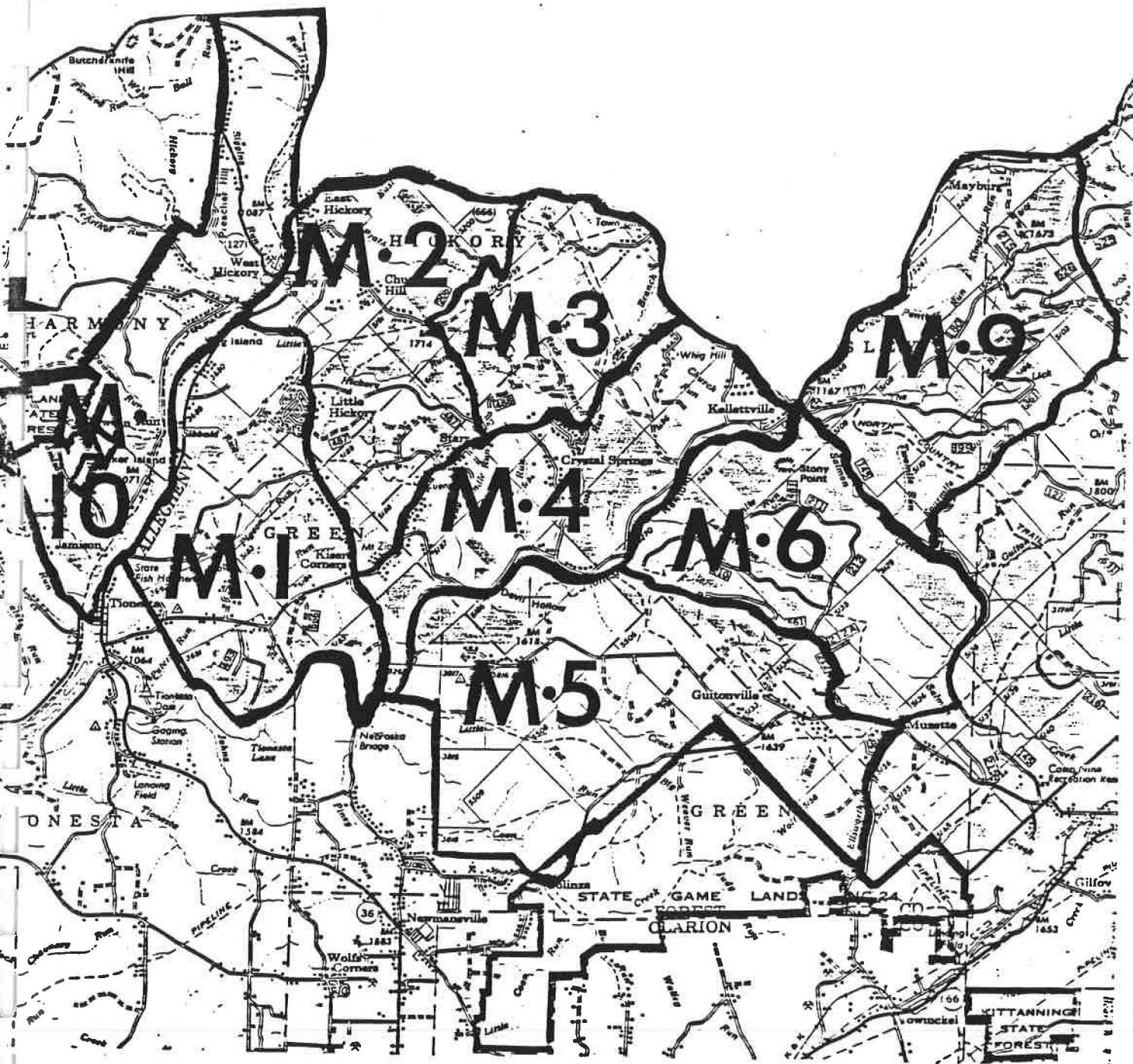
Map 13. 1988 Gypsy Moth Egg Mass Survey Entomological Areas
Allegheny National Forest, Bradford Ranger District.



Map 14. 1988 Gypsy Moth Egg Mass Survey Compartments
Allegheny National Forest, Bradford Ranger District.



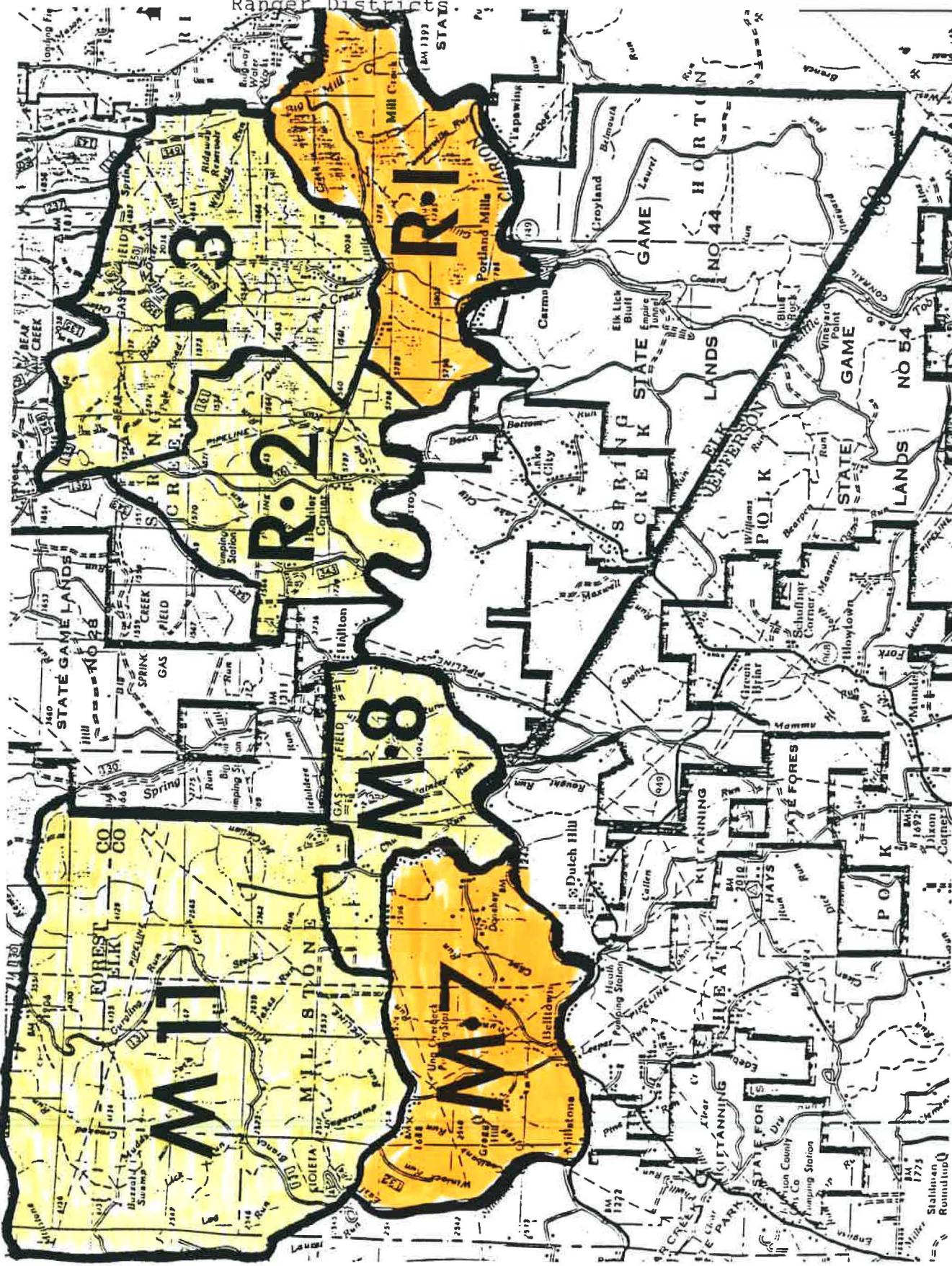
Map 15. 1988 Gypsy Moth Egg Mass Survey Entomological Areas
Allegheny National Forest, Marienville Ranger District.



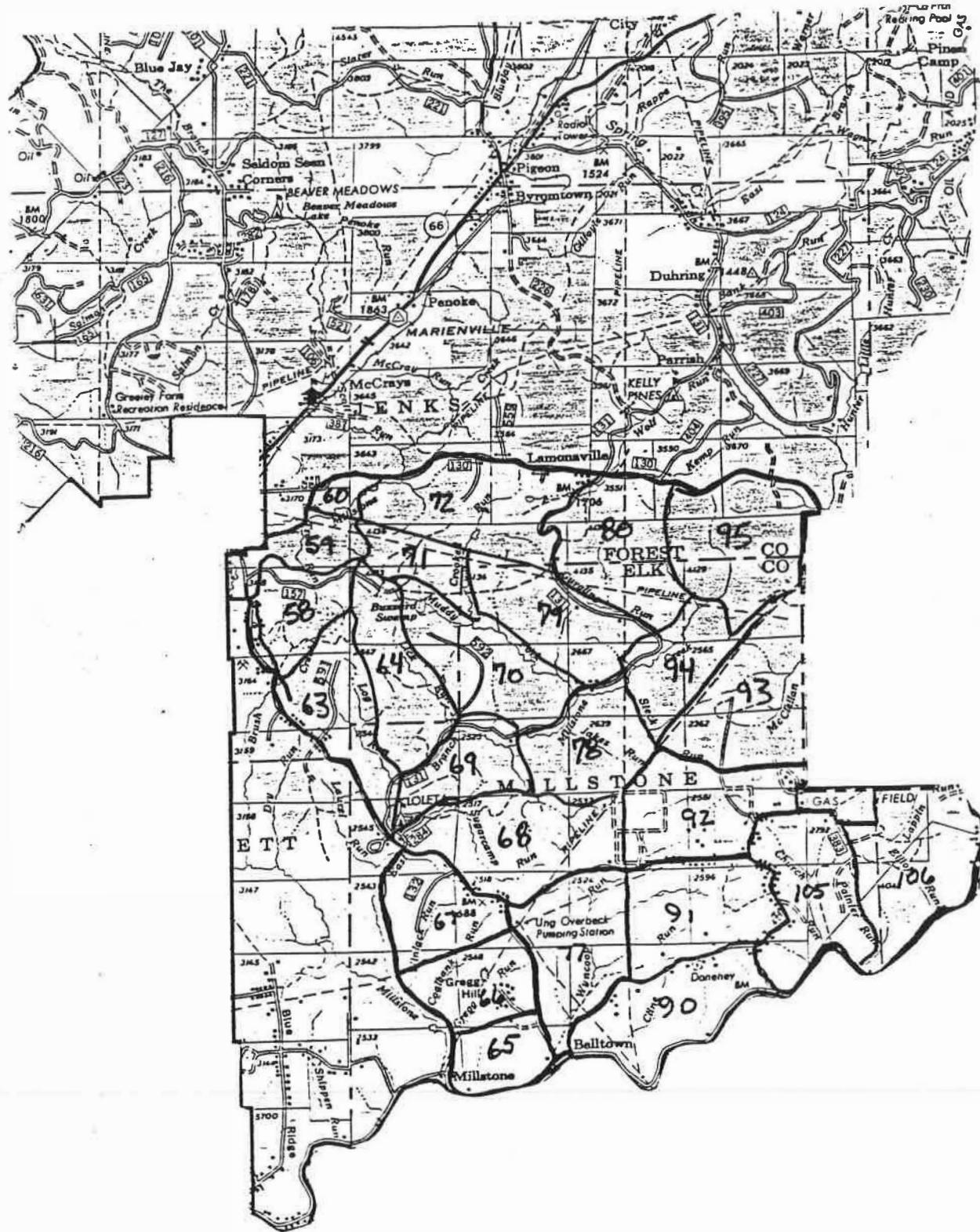
Map 16. 1988 Gypsy Moth Egg Mass Survey Compartments,
Allegheny National Forest, Marienville Ranger District.



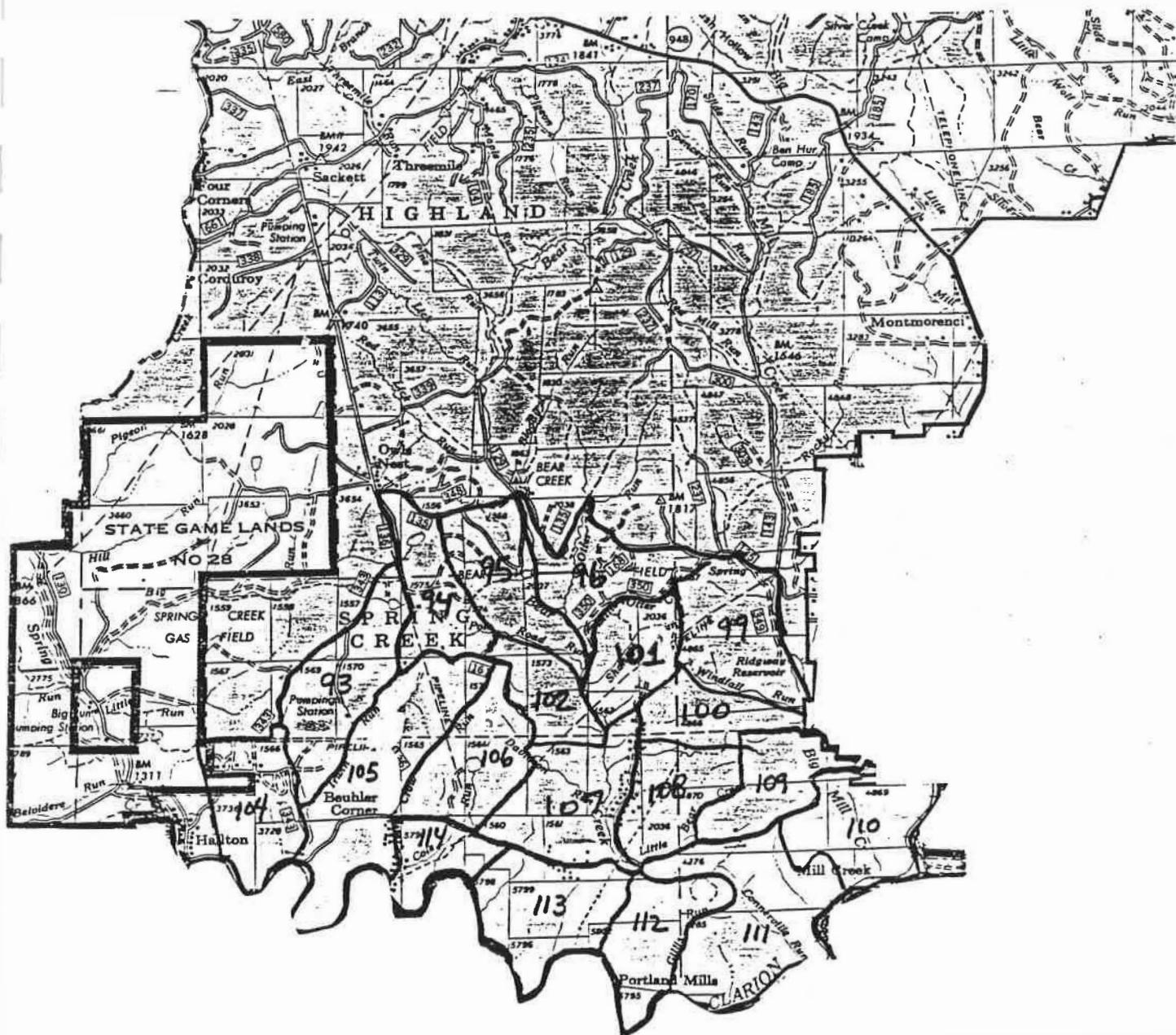
Map 17. 1988 Gypsy Moth Egg Mass Survey Entomological Areas,
Allegheny National Forest, S.E. Marienville and Ridgway
Ranger Districts



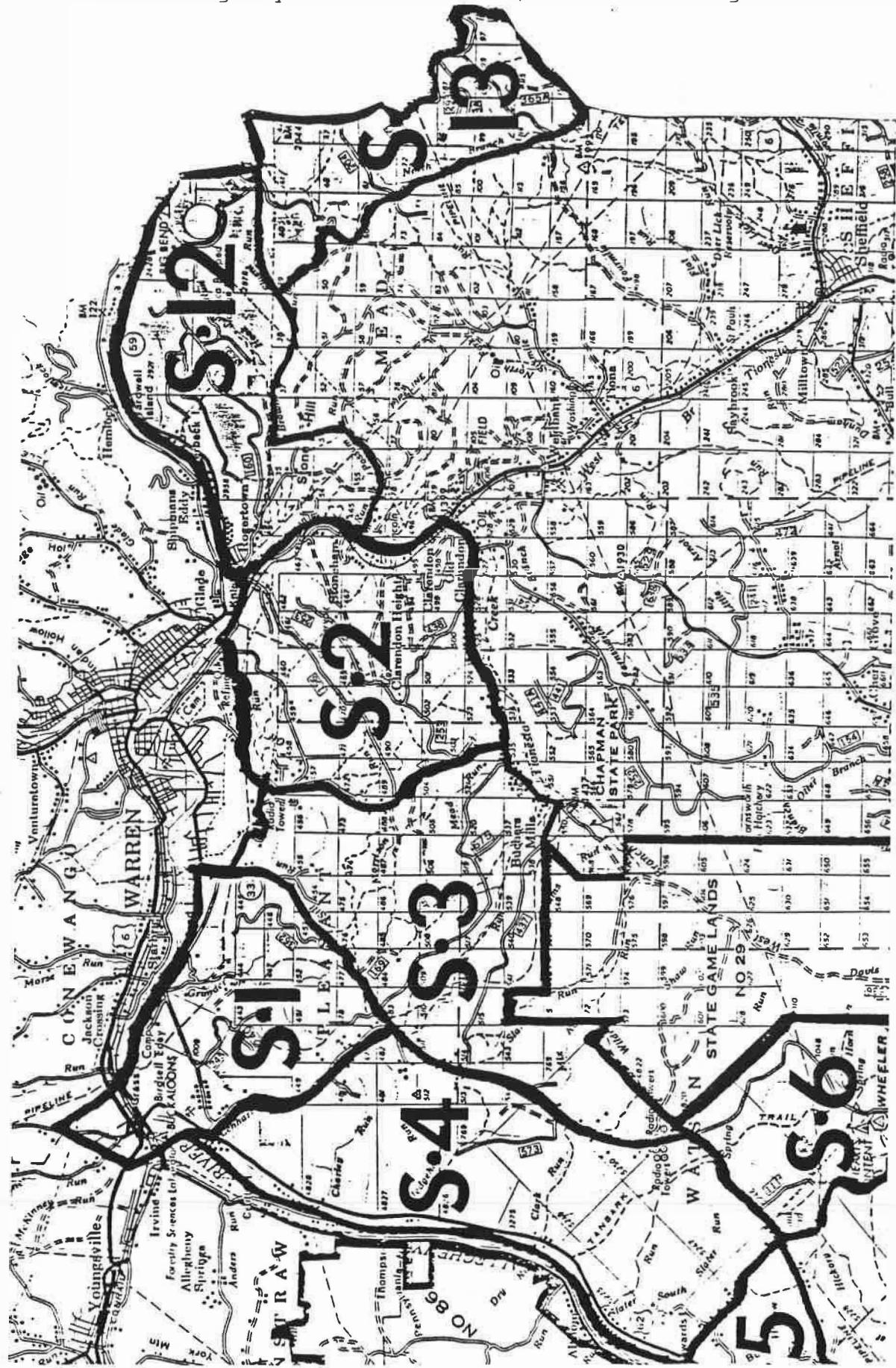
Map 18. 1988 Gypsy Moth Egg Mass Survey Compartments,
Allegheny National Forest, Marienville Ranger District.



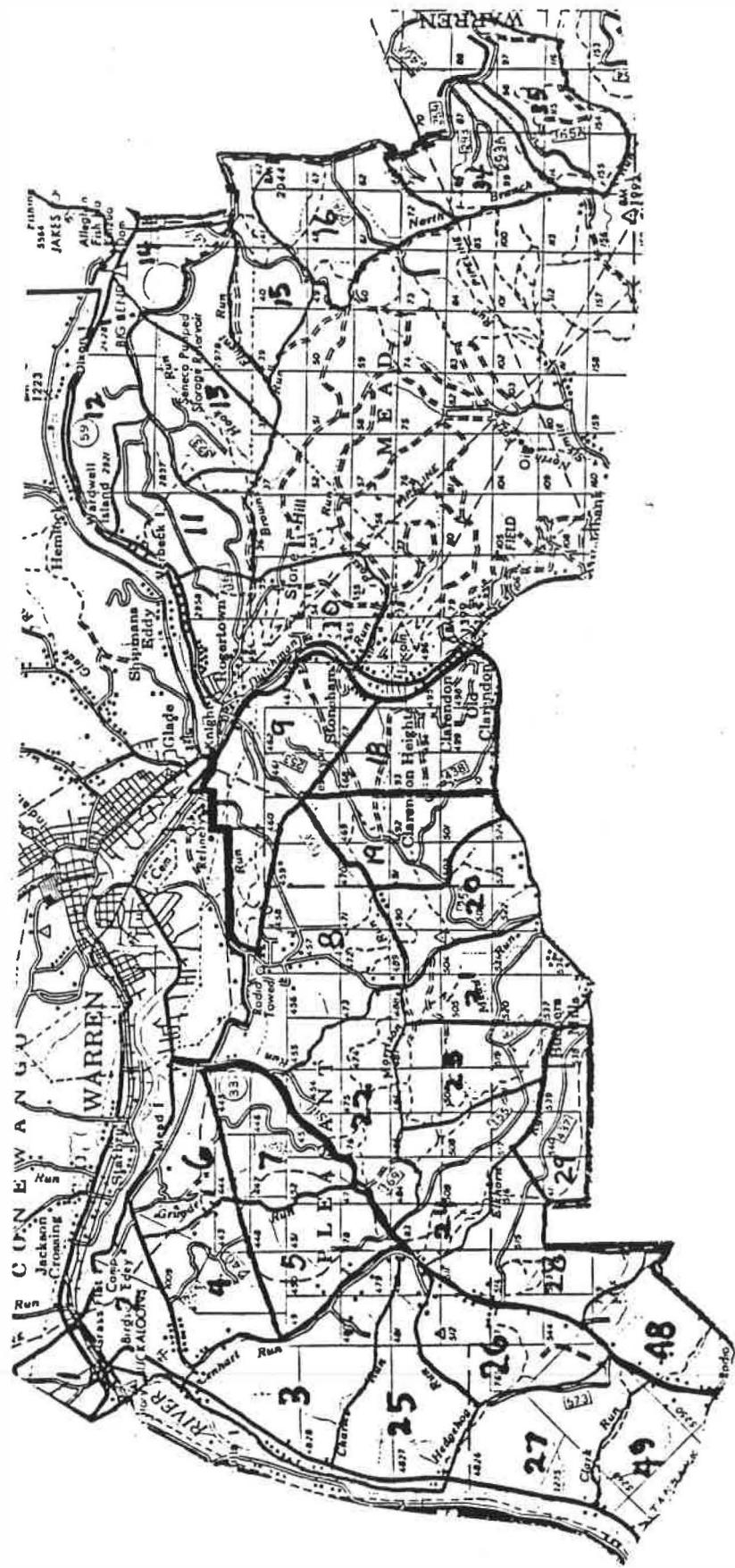
Map 19. 1988 Gypsy Moth Egg Mass Survey Compartments,
Allegheny National Forest, Ridgway Ranger District.

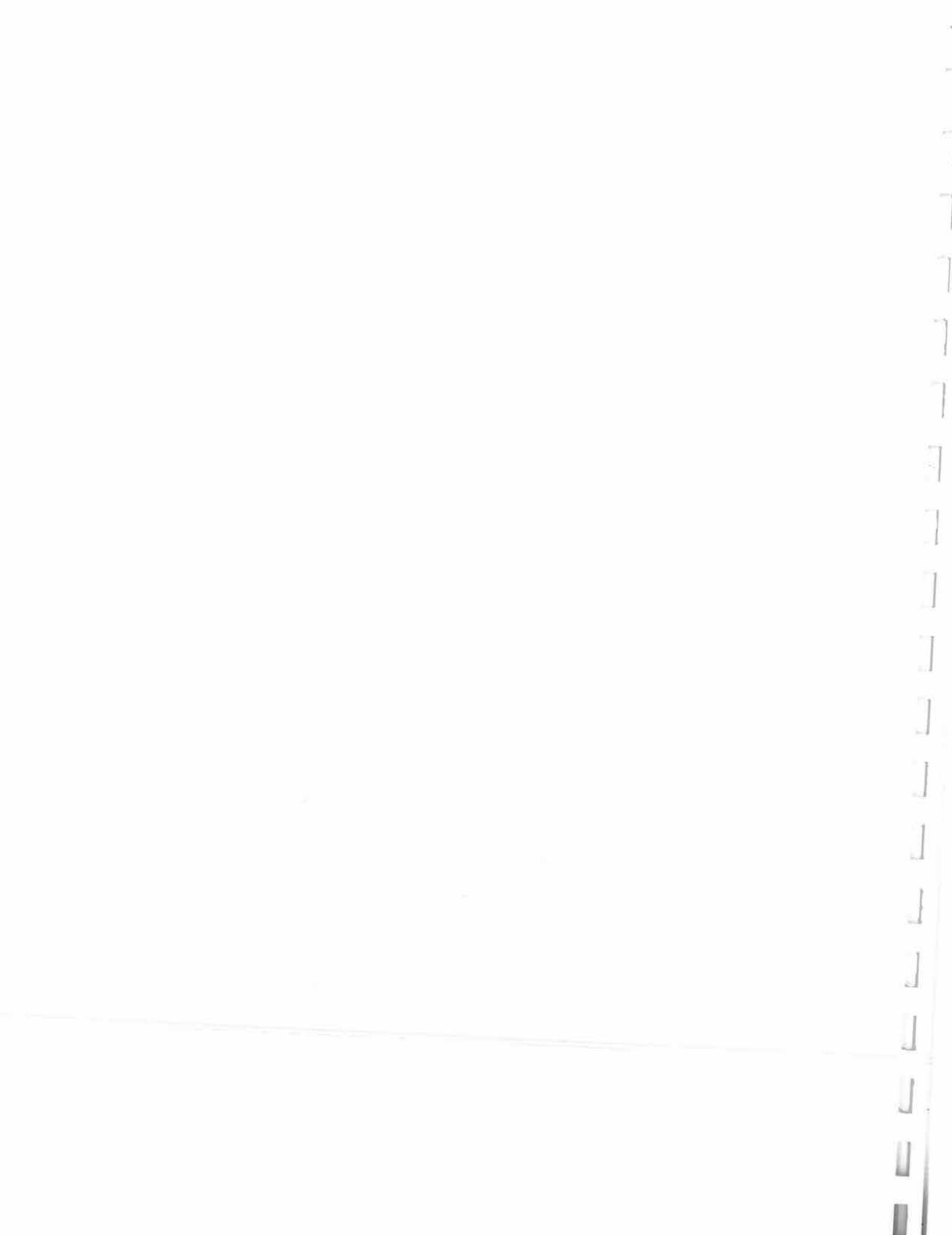


Map 20. 1988 Gypsy Moth Egg Mass Survey Entomological Areas,
Allegheny National Forest, Sheffield Ranger District.

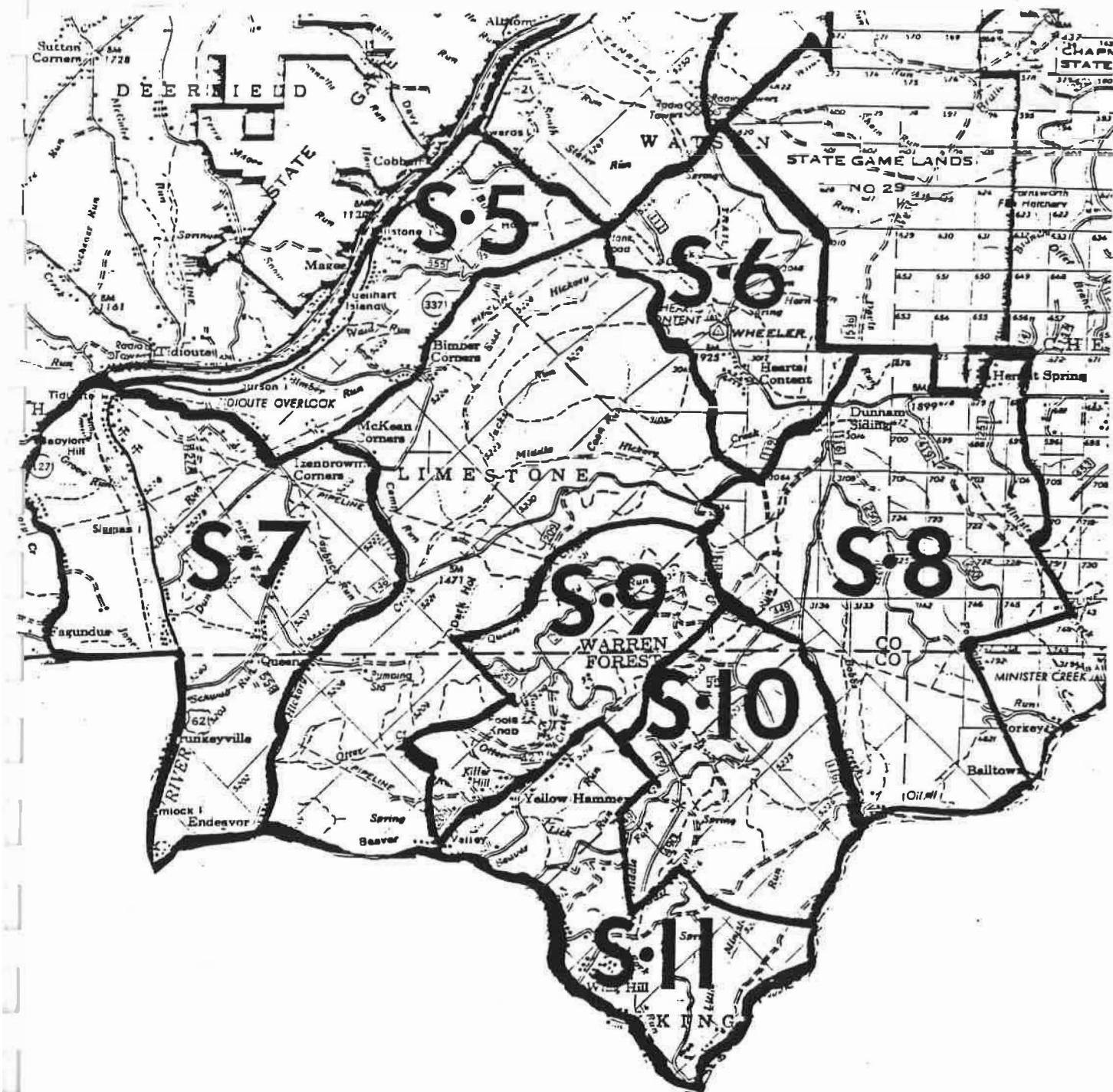


Map 21. 1988 Gypsy Moth Egg Mass Survey Compartments,
Allegheny National Forest, Sheffield Ranger District.





Map 22. 1988 Gypsy Moth Egg Mass Survey Entomological Areas,
Allegheny National Forest, Sheffield Ranger District.



Map 23. 1988 Gypsy Moth Egg Mass Survey Compartments,
Allegheny National Forest, Sheffield Ranger District.



